DOCUMENTED CHROMOSOME NUMBERS 1996:1. CHROMOSOME NUMBERS IN *CAREX* SECTION *OVALES* (CYPERACEAE) FROM EASTERN NORTH AMERICA

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ABSTRACT

Chromosome counts for seventeen species of *Carex* section *Ovales* are reported. They range from $n=26$ + IV to $n=40$. Counts for *Carex alata*, *C. hyalina*, *C. longii*, *C. ozarkana*, *C. reniformis*, *C. suberecta*, *C. tincta*, and *C. vexans* were determined for the first time and included 3 aneuploid (sensu lato) series. Four species (*C. albolutescens*, *C. hormathodes*, *C. straminea*, and *C. tribuloides*) yielded counts similar to previously published results. On the other hand, two species (*C. cumulata* and *C. silicea*) differed from previous reports and represent possible aneuploidy, while aneuploidy was demonstrated for *C. festucacea*.

RESUMEN

Se realizan recuentos cromosómicos de diez y siete especies de *Carex* sección *Ovales*. Su número varia de $n=26$ + IV hasta $n=40$. Se realizan por primera vez recuentos de *Carex alata, C. hyalina, C. longii, C. ozarkana, C. reniformis, C. suberect, C. tincta* y *C. vexans* que incluyen tres series aneuploides (sensu lato). Cuatro expecies (*C. albolutescens, C. hormathodes, C. straminea* y *C. tribuloides*) dieron recuentos similares a resultados publicados previamente. Por otro lado, dos especies (*C. cumulata* y *C. silicea*) difieren de los recuentos previos y representan aneuploidia posible, mientras que se demostró la existencia de aneuplodía en *C. festucacea*.

INTRODUCTION

Carex L. section *Ovales* Kunth includes approximately 40 species in eastern North America with a deserved reputation for being taxonomically difficult. In contrast with other sections of *Carex*, Gleason and Cronquist (1991) describe species of section *Ovales* as narrowly defined and more or less confluent. In spite of there being only subtle morphological differences

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between many species of this section, the karyotypes among them vary widely and reinforce the established species concepts.

Eastern North American species have haploid numbers ranging from 26 to 40 (Whitkus 1991). For some species in which multiple plants have been studied cytologically, the counts are constant. Such is the case for *C. crawfordii* Fernald (plants from 9 populations) *C. normalis* Mack. (4 plants) and *C. molesta* Mack. ex Bright (3 plants) as well as *C. cristatella* Britton, *C. projecta* Mack., and *C. tribuloides* Wahlenb. with 2 plants each (Wahl 1940; Whitkus 1991). On the other hand, other species (*C. bebbii* (L.H. Bailey) Fernald, *C. bicknellii* Britton, *C. merritt-fernaldii* Mack., and *C. tenera* Dewey) reportedly have narrow aneuploid, or more specifically, agmatoploid series. One species, the polymorphic *C. scoparia* Willd., may have a broader aneuploid series (Whitkus 1991). Two species studied thus far, *Carex festucacea* Willd. and *C. scoparia*, exhibited multivalents or univalents at meiosis metaphase I (Wahl 1940; Tanaka 1942).

The frequent aneuploidy in *Carex* is thought to be a consequence of polycentric chromosomes with diffuse centromeres (Grant 1981). If a polycentric chromosome fragments, even small chromosomal pieces have the potential of completing normal movements during mitosis and meiosis. Thus, in this particular kind of aneuploidy known as agmatoploidy, changes in chromosome number may be readily preserved. Furthermore, unlike taxa with monocentric chromosomes, these variations in *Carex* chromosome number do not effect fertility within a taxon (Whitkus 1988).

In spite of numerous chromosome studies of these species, many species of *Carex* section *Ovales* have yet to be examined cytologically. At the same time, given the known potential for variation in chromosome number within species of this section (Heilborn 1932; Wahl 1940; Tanaka 1942; Moore & Calder 1964; Packer & Whitkus 1982; Whitkus & Packer 1984; Whitkus 1991), additional counts are necessary for those species with only single or few counts. This study contributes to our understanding of karyology within section *Ovales* by reexamining 7 taxa and reporting the chromosome counts for 10 taxa for the first time.

MATERIALS AND METHODS

Living plants were collected during the flowering or fruiting season and cultivated in a sand-peat-perlite potting medium in 10–15 cm pots under greenhouse conditions. During the growing season, dilute liquid fertilizer was applied approximately monthly. Plants were cold treated (0–5° C) for 3–4 months to stimulate the production of new inflorescences.

Immature spikes were collected and preserved in methanol, chloroform, and propionic acid (6:3:2). Within the subsequent 72 hours, anthers were dissected from the spikes and squashed in 2% lactic-acetic-orcein

(Cooperrider & Morrison 1967). Meiosis I chromosome figures were examined from five or more pollen mother cells. Drawings and photographs were made with a Nikon Labophot-2 microscope using phase contrast at 1000x magnification.

Voucher herbarium specimens were typically prepared at the time of field collection. In some cases, where material was being supplied by correspondence or field material was not fruiting, voucher specimens were later prepared from greenhouse material. Vouchers, on deposit at the University of Michigan Herbarium (MICH), include drawings and photomicrographs of countable figures.

RESULTS AND DISCUSSION

The chromosome counts for the 17 taxa reported in this study ranged from $n=26$ + IV to $n=40$ (Table 1), approximating the known range of $n=26$ to 45 for the section as a whole (Whitkus 1991). Of the 11 species for which multiple individuals were investigated, three new aneuploid (sensu lato) series were discovered. Of the species being reexamined, four had the same numbers as previous reports, while three others were different, indicating possible aneuploidy.

Carex alata Torr. The three counts of $n=37$ are the first reported for this species. Although the plants were all collected in southwestern Michigan, the habitats sampled were diverse. The Berrien County site was a wet prairie opening, the first Kalamazoo County site (#2522) was a *Sphagnum* bog, and the second Kalamazoo County site (#2527) was a peaty *Acer rubrum* swamp. The plants varied widely in robustness with those of the *Acer rubrum* swamp having the most gracile form. Morphologically this species has the obovate perigynia of *C. albolutescens* Schwein., *C. cumulata* (L.H. Bailey) Fernald, *C. longii* Mack., and *C. ozarkana* P. Rothr. & Reznicek, all of which have lower, sometimes markedly lower, chromosome numbers. The $n=37$ is identical with that observed for *C. straminea* Willd. and *C. hormathodes* Fernald, species that also have the awned pistillate scales and stipitate achenes seen in *C. alata*.

Carex albolutescens Schwein. Both of our plants, from widely differing parts of the range, had an $n=33$. Wahl (1940) reported $n=33$ for an unidentified plant from section *Ovales* which he listed as *C.* sp. 15168. Examination of his voucher specimen (at PAC) from Centre County, Pennsylvania confirmed that it is *C. albolutescens*.

This species has often been confused with *C. longii* and *C. festucacea* (Rothrock 1991). The distinctive chromosome counts support the morphological analysis which indicated that these taxa are best recognized as distinct species.

Carex bicknellii Britton var. **opaca** F.J. Herm. An $n=33$ was observed

TABLE 1. Chromosome number and location of species of *Carex* examined.

Species	*n*	Location: Voucher
Carex alata Torr.		
	37	Berrien Co., MI: *P.E.R. 2531*
	37	Kalamazoo Co., MI: *P.E.R. 2522*
	37	Kalamazoo Co., MI: *P.E.R. 2527*
C. albolutescens Schwein.		
	33	Berrien Co., MI: *P.E.R. 2532*
	33	Columbus Co., NC: *A.A.R. 8972*
C. bicknellii Britt. var. *opaca* F.J. Herm.		
	33	LeFlore Co., OK: *P.E.R. 2916*
C. cf. *brevior* (Dewey) Mack.		
	37	Garland Co., AR: *P.E.R. 2904*
C. cumulata (L.H. Bailey) Mackenzie		
	29	Newton Co., IN: *P.E.R. 2538*
	29	Hancock Co, ME: *A. Dibble s.n.*
C. festucacea Willd.		
	34	Tallahatchie Co., MS: *P.E.R. 2944*
	35	Lonoke Co., AR: *P.E.R. 2890*
C. hormathodes Fernald		
	37	Hancock Co., ME: *A.A.R. 9162*
	37	Knox Co., ME: *A. Dibble s.n.*
C. hyalina Boott		
	37	Tunica Co., MS: *P.E.R. 2947*
C. longii Mack.		
	28+IV	Berkeley Co., SC: *R. Wilbur 52789*
	31	Flagler Co., FL: *P.E.R. 2380*
	31	Indian River Co., FL: *P.E.R. 2375B*
	31	Kalamazoo Co., MI: *P.E.R. 2525*
C. ozarkana P. Rothr. & Reznicek		
	26+IV	LeFlore Co., OK: *P.E.R. 2917*
	28+III	Garland Co., AR: *P.E.R. 2913*
	31	Perry Co., AR: *P.E.R. 2914*
C. reniformis (L.H. Bailey) Small		
	40	Clark Co., AR: *P.E.R. 2909*
	40	Quitman Co., MS: *P.E.R. 2945*
	40	Stoddard Co., MO: *P.E.R. 2936*
C. *silicea* Olney		
	37	Hancock Co., ME: *A. Dibble s.n.*
C. straminea Willd.		
	37	Newton Co., IN: *P.E.R. 2537*
	37	Kalamazoo Co., MI: *P.E.R. 2523*
	37	Shannon Co., MO: *P.E.R. 2928*
C. suberecta (Olney) Britton		
	36	Madison Co., IN: *P.E.R. 2314*
	36	Kalamazoo Co., MI: *P.E.R 2528*

TABLE 1. (continued.)

Species	*n*	Location: Voucher
C. tincta Fernald		
	36+IV	Penobscot Co., ME: *A.A.R. 9122*
C. tribuloides Wahlenb.		
	35	Lonoke Co., AR: *P.E.R. 2897*
C. vexans F.J. Herm.		
	33+III	Pasco Co., FL: *P.E.R. 2379*
	34	Hendry Co., FL: *P.E.R. 2376*
	35	Hillsborough Co., FL: *P.E.R. 2378*
	35	Indian River Co., FL: *P.E.R. 2375*

for this variety from the south central U.S. Previous counts of $n=37$ (Löve & Löve 1981) and $n=38$ (Tanaka 1942) were for the typical, more northerly variety. Given the strikingly different chromosomal condition, a reevaluation of the taxonomic status of this variety is being undertaken.

Carex cf. **brevior** (Dewey) Mack. This plant from the Ozark Mountains has an $n=37$. It is morphologically close to *C. brevior* and *C. molesta* but has a notably higher chromosome number. Löve and Löve (1981) reported $n=34$ for *C. brevior* and *C. molesta*. Wahl (1940) also observed $n=34$ for *C. molesta*. Our plant has the wide achenes of *C. brevior* but the rounded spike bases and ventrally nerved perigynia of *C. molesta*. Preliminary morphological evaluation suggests that this is an undescribed taxon.

Carex cumulata (L.H. Bailey) Mack. The only published count for this species (Löve & Löve 1981) is $n=28$. Our report of $n=29$ is based upon two plants from Newton County, Indiana and one from Hancock County, Maine. *Carex cumulata* is an uncommon species from barren sandy habitats with affinities to *C. longii*.

Carex festucacea Schkuhr ex Willd. Wahl (1940) reported that this species had a chromosome count of $n=33$ + III. Our material, with $n=34$ and $n=35$, showed no trivalents but does demonstrate an aneuploid series.

Carex hormathodes Fernald. Our counts of $n=37$ from plants of Maine confirmed that reported by Wahl (1940) for a plant from Rehobeth, Delaware. *Carex hormathodes* has sometimes been treated as a variety of *C. straminea* which also has $n=37$. The two seem, however, to consistently differ in habitat and in the shape of the spikes and the beak of the perigynium.

Carex hyalina Boott. The count of $n=37$ is the first for this rare species of northeast Texas, Arkansas, Oklahoma, and Mississippi. Correll and Johnson (1970) suggest that *C. brittoniana* L.H. Bailey most resembles this species. Unfortunately, no chromosome count exists for that species. *Carex hyalina* also bears some notable similarity to *C. reniformis* (L.H. Bailey)

Small. Both occur in floodplain woods and have short-creeping rootstocks, blunt pistillate scales, and perigynia with green beak and shoulders and fine papillae. On the other hand, the width of their perigynia and achenes are strikingly different.

Carex longii Mack. This widespread member of section *Ovales* represents another aneuploid series, $n=28$ + IV and $n=31$. Our collections include individuals from the heart of its range on the Atlantic Coastal Plain as well as from the Great Lakes region. The comparatively low chromosome number compares favorably to that of *C. albolutescens* and *C. cumulata*, species with close morphological affinities to *C. longii*.

Carex ozarkana P. Rothr. & Reznicek. This newly described species, with a narrow geographic range centered on the Ozark and Ouachita Mountains of Arkansas and Oklahoma, displays limited morphological variability. Nevertheless, it has a variable chromosome condition, $n=26$ + IV, $n=28$ + III, and $n=31$. Based upon morphological considerations, Rothrock and Reznicek (1995) concluded that *Carex ozarkana* is most closely allied with *C. longii*.

Carex reniformis (L.H. Bailey) Small. This relatively distinctive member of section *Ovales* gave a constant count of $n=40$. The Clark County, Arkansas site is in the eastern Ozark Mountains, while the other two sites are within the Mississippi River embayment.

Carex silicea Olney. Two plants from a site in Hancock County, Maine gave $n=37$. Moore and Calder (1964) have previously reported $n=38$ for this species, suggesting possible aneuploidy. Mackenzie (1931) aligned *C. silicea* with other species having obovate perigynia, including *C. albolutescens*, *C. cumulata*, and *C. longii*. Compared to these species, however, *Carex silicea* has a much higher chromosome number, frequent auricula at the base of its leaf blades, moniliform inflorescences, long pistillate scales, and somewhat papillose perigynia. The relationship of this distinctive coastal sand dune species to other *Ovales* species needs further investigation.

Carex straminea Willd. in Schkuhr. All plants examined had $n=37$, including those from disjunct populations in Shannon County, Missouri and Kalamazoo County, Michigan. These counts confirm that reported by Wahl (1940) under the synonymous name *C. richii* Mack.

Carex suberecta (Olney) Britton. The two counts of $n=36$ are the first reported for this fen species. Among those species with proximate chromosome counts, *Carex hormathodes* and *C. straminea* ($n=37$) are likely the closest relatives of *C. suberecta*.

Carex tincta Fernald. This species is locally frequent in Maine and New Brunswick and is known from scattered localities as far west as northern Illinois, Michigan, Wisconsin, and Ontario. Its affinity with other species is unknown. The chromosome count of $n=36$ + IV is the first for this species.

Carex tribuloides Wahlenb. Wahl (1940) and Moore and Calder (1964) reported $n=35$ for northern plants of this species. Our plant, from the southern part of the range, also has an $n=35$ but has the shorter perigynia and smaller spikes of variety *sangamonensis* Clokey.

Carex vexans F.J. Herm. The counts for this Florida endemic revealed another aneuploid series, $n=33$ + III, $n=34$, and $n=35$. *Carex vexans*, like *C. ozarkana*, links a narrow geographic distribution and relatively limited morphological variation with variable karyotypes. *Carex vexans* is probably most closely related to *C. alata*, with which it was often confused before being described as a distinctive species. Unlike *C. alata*, *C. vexans* lacks awns on the pistillate scales and its perigynia have longer, more gradually tapered beaks.

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